

## Cosmology Coverage

Subir Sarkar

*Oxford University*

[Big-Bang cosmology \(Rev.\)](#)

[Big-Bang nucleosynthesis \(Rev.\)](#)

[Cosmological parameters \(Rev.\)](#)

[Dark matter \(Rev.\)](#)

[Cosmic microwave background \(Rev.\)](#)

## Reviews

- **Big-Bang Cosmology:** Keith Olive (Minnesota) & John Peacock (Edinburgh)
  - **Big-Bang Nucleosynthesis:** Brian Fields (Illinois) & Subir Sarkar (Oxford)
  - **Cosmological Parameters:** Ofer Lahav (UC London) & Andrew Liddle (Sussex)
  - **Dark Matter:** Manuel Drees (Bonn) & Gilles Gerbier (CEA Saclay)
  - **Cosmic Microwave Background:** Douglas Scott (UBC) & George Smoot (LBL)
- 8 theorists, 2 experimentalists (5 European, 1 Indian & 4 North American)
- Fast moving field so all reviews need to be updated *annually*
- Need for new reviews?

### Hubble expansion

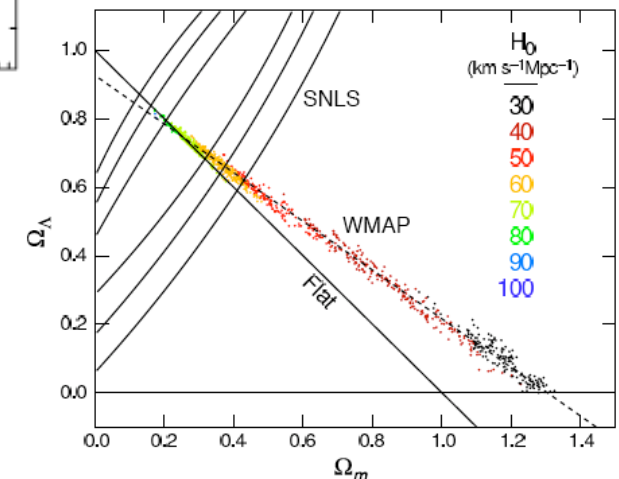
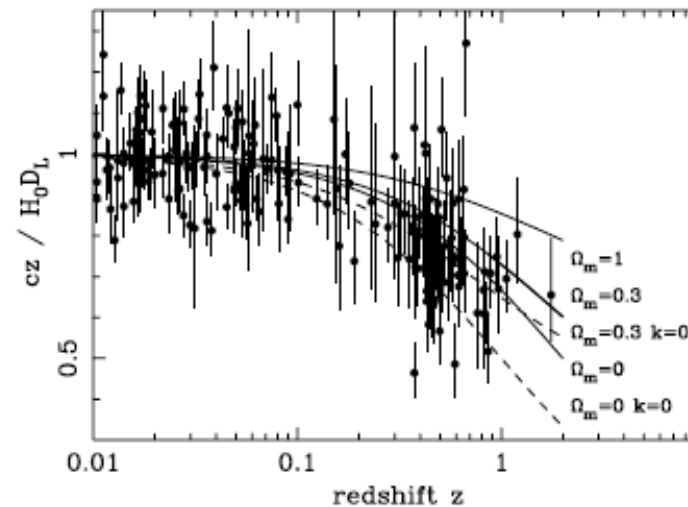
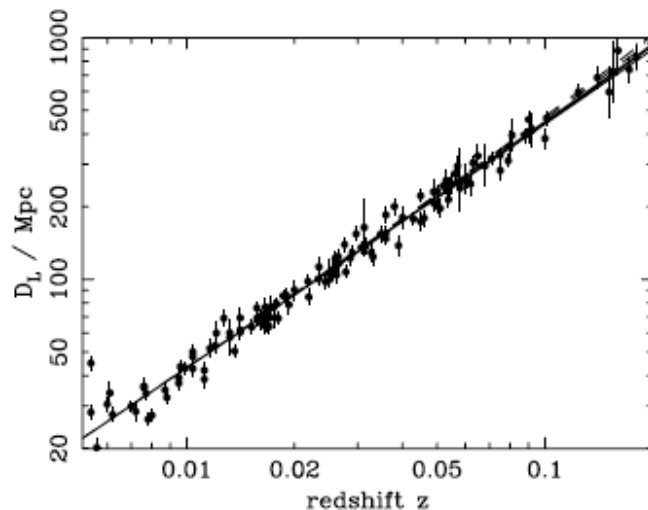
... used to be written by Masataka Fukugita & Craig Hogan - *essential* in view of recent concerns about homogeneity/isotropy, anomalously large bulk flows etc

### Gamma-ray Astronomy

... amazingly productive field in recent years (HESS, MAGIC, VERITAS; Milagro)  
now: GLAST/FERMI; forthcoming CTA, AGIS, HAWC etc)

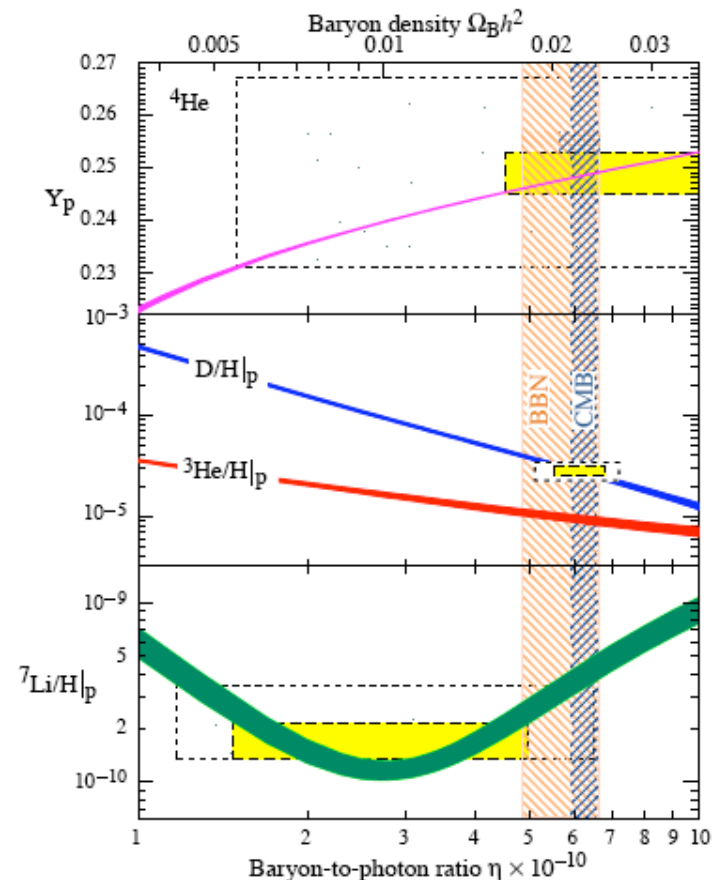
# Big Bang Cosmology

- Succint (31 p) overview of standard model
- Introduces concepts, notation, links between other reviews
- Discusses observational basis (for dark energy domination)



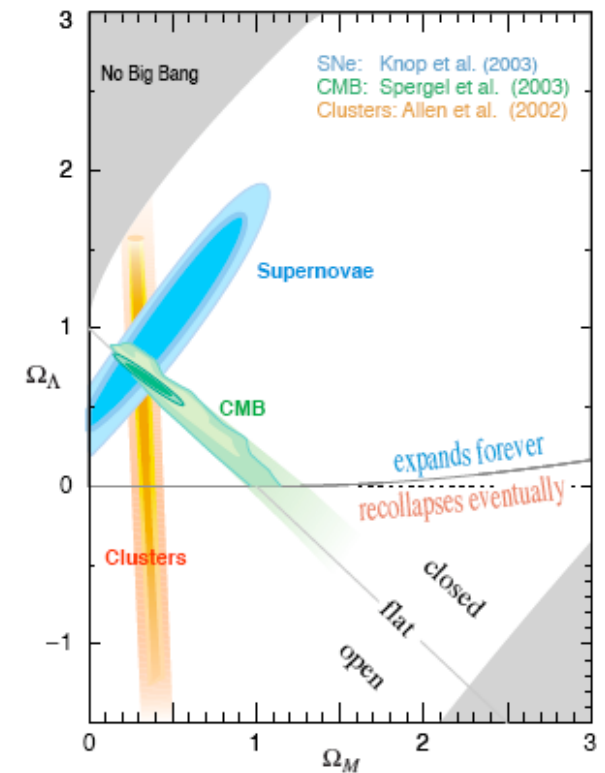
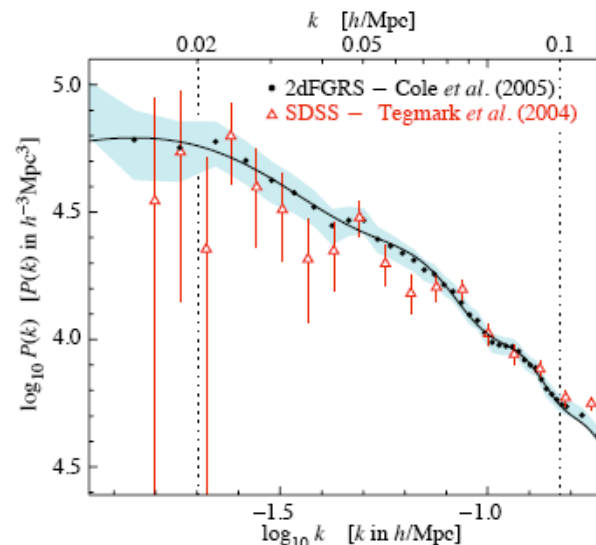
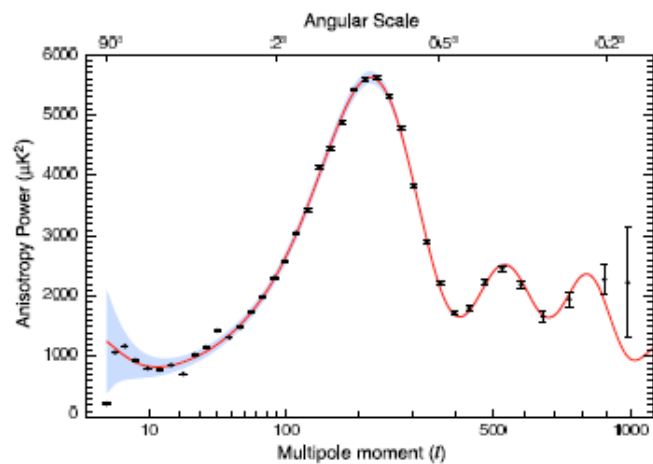
# Big Bang Nucleosynthesis

- Summary of ‘deepest direct probe of the Big Bang’
- Critique of quoted *inferred* primordial abundances
- Emphasises agreement with CMB determination of  $\eta$
- Constraints on new physics
- ‘Cloud on horizon’ ...  
the Lithium problem  
(new physics?)



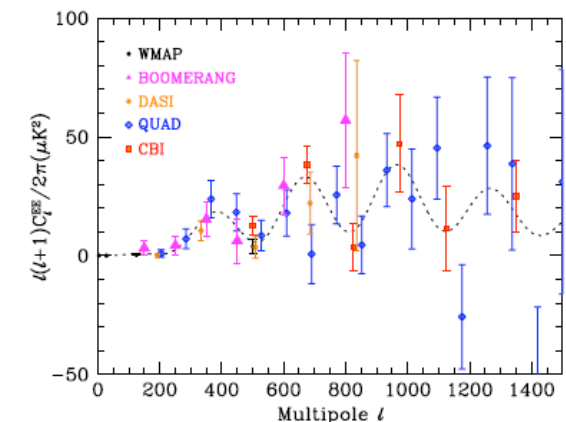
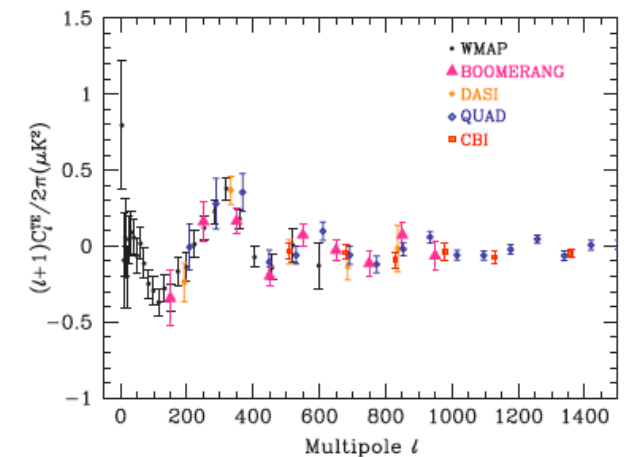
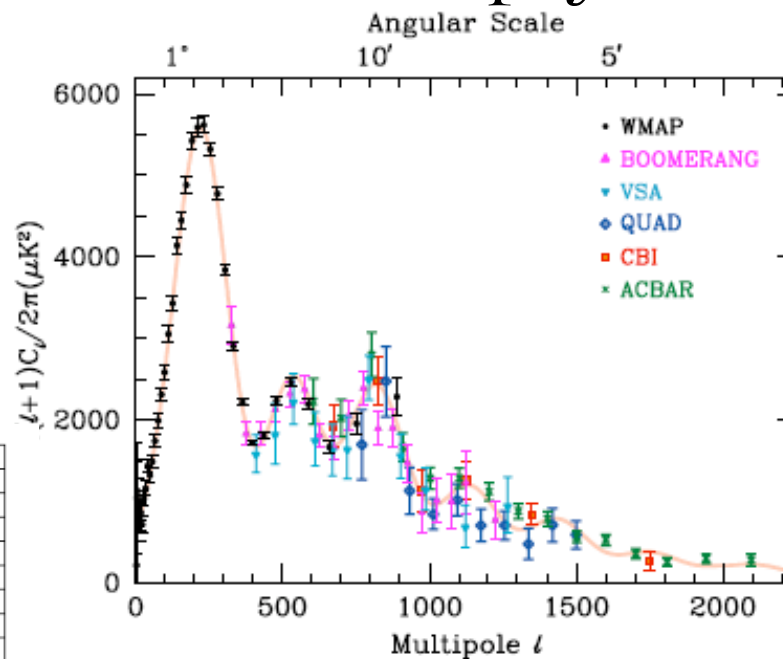
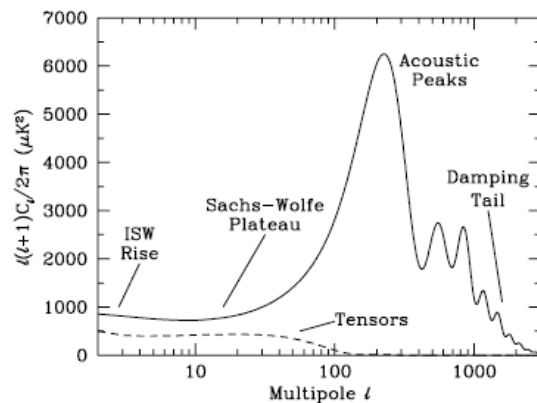
# Cosmological Parameters

- Some overlap with cosmology and CMB review
- Discussion of density perturbation generation from inflation and growth of large-scale structure
- Wide-ranging survey of different techniques for measuring content of universe



# Cosmic Microwave Background

- Discussion of physics of CMB anisotropy generation
- Summary of current observations and implications for cosmological parameters
- Constraints on fundamental physics



# Dark Matter

- Astronomical evidence for dark matter
  - New particle candidates
  - Detailed discussion of experimental approaches to WIMP and axion detection
- ... both direct and indirect searches

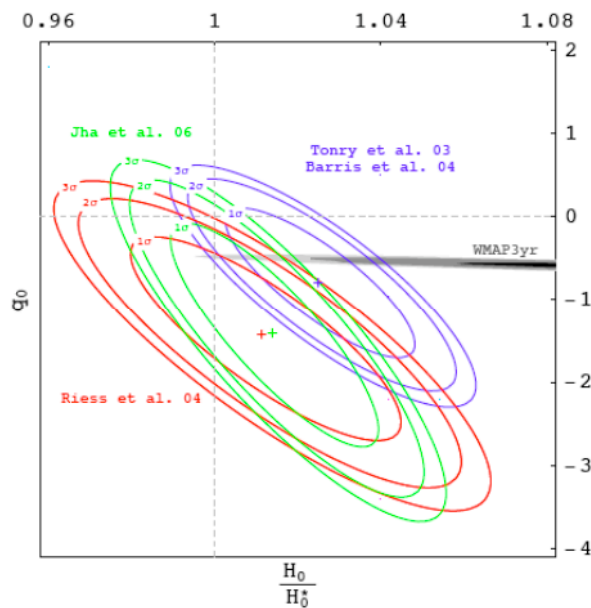
No pictures!

# Why a review of Hubble expansion is necessary?

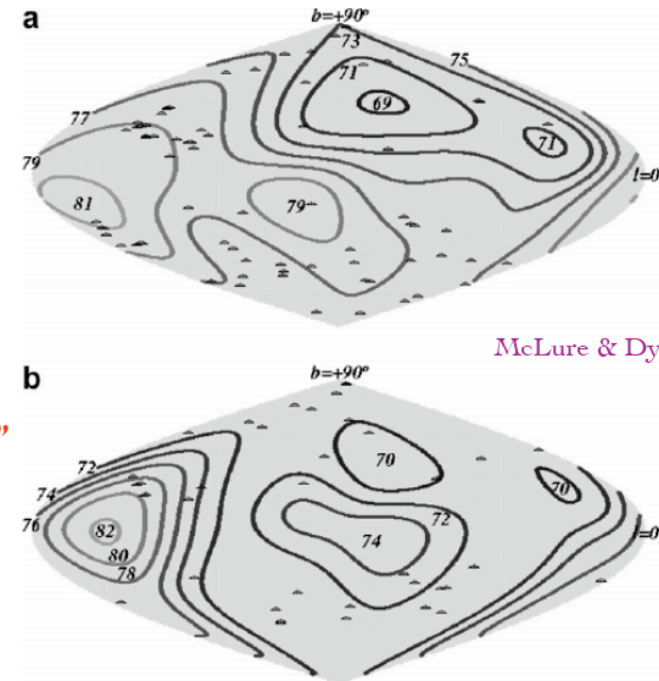
The HKP data do show significant variations of up to  $9 \text{ km s}^{-1} \text{ Mpc}^{-1}$  across the sky

Not all observers agree on interpretation of HKP data  
eg.  $62.3 \pm 1.3$  vs.  $72 \pm 8 \text{ km/s/Mpc}$

“... our model independent test cannot exclude the case of the deceleration of the expansion at a statistically significant level”



**Fig. 3.** Confidence contours for a model-independent full-sky fit to the Hubble law at second order for three SNe Ia data sets. SNe up to redshift  $z = 0.2$  are included in the fits. (Schwarz & Weinhorst 2007)



McLure & Dyer (2007)

.. as does an independent sample of objects

Concerns about consistency between different SNIa datasets and analyses, ...



# Why a review of $\gamma$ -ray astronomy is necessary?

VERITAS (NSF+DOE+Smithsonian)



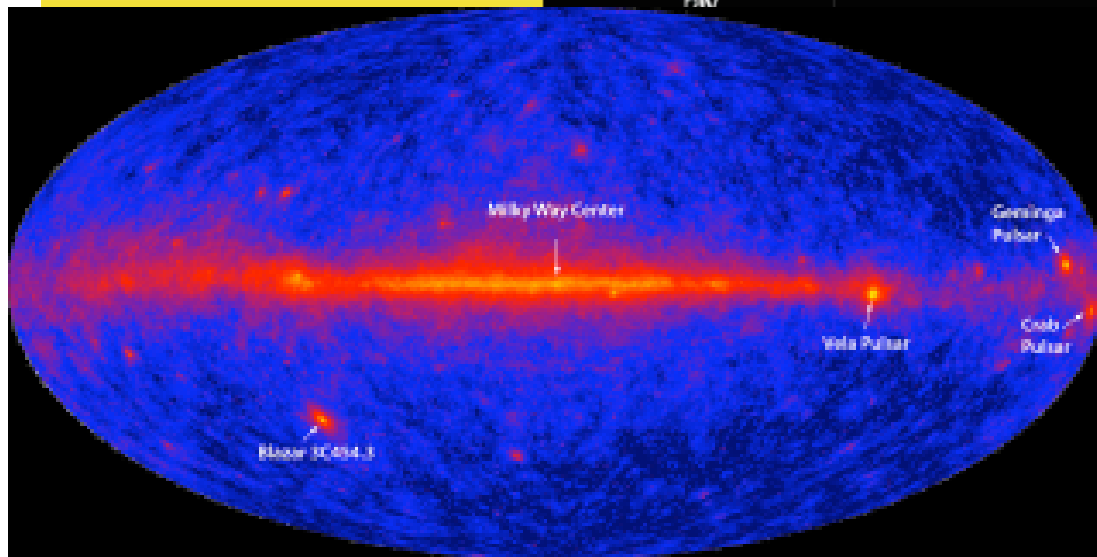
MAGIC x 2



HESS 2



Gamma-ray



**Fermi**  
Gamma-ray Space Telescope



Arguably most productive area in astroparticle physics ... for both astro and particle physics!